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(54) Method for manufacturing a bifocal contact lens and means to be used in this method.

(57) A contact lens comprising an optical zone shifted with respect to the axis of the contact lens, is manufactured in a first embodiment by cutting a lens basic part with the desired contact lens diameter centrically on a disc-shaped blank. The optical zone and the periphery are cut eccentrically in the lens basic part, for example by means of an auxiliary tool with a mounting part for mounting in a lathe and a receiving space for the blank mutually shifted along the desired distance, an eccentric collet or a tool mounted eccentrically with respect to the collect.

In the second embodiment a lens basic part with the desired contact lens diameter is cut eccentrically on a blank. Subsequently the optical zone and the periphery are cut centrically with respect to the blank in the lens basic part.

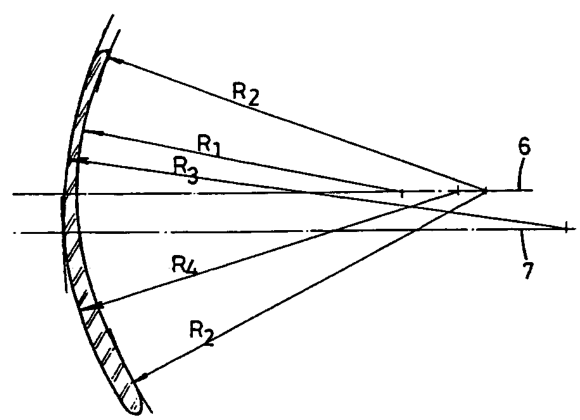


Fig.2

EP 0 566 170 A1

The invention relates to a method for manufacturing a contact lens, comprising an optical zone and a periphery, wherein the optical zone is shifted with respect to the axis of the contact lens in such a manner that an inner prism is obtained with the desired prism dioptre, and to auxiliary tools to be used in this method.

A bifocal contact lens mainly corresponds with a standard contact lens, wherein the outer side of the lens in the distance zone is cut with a first radius and in the reading zone with a second radius, the second radius being substantially smaller than the first radius. In the conventional bifocal contact lens the optical zone and the periphery are cut in a usual manner centrically with respect to the axis of the lens. Thereby, the conventional bifocal contact lens shows a thickness of the contact lens in the distance zone at the lower side thereof which is relatively high. Thereby the use of the conventional bifocal contact lens is found unpleasant. Moreover, a big lachrymal film is formed at the location of the relatively thick edge of the reading zone which affects the operation of the reading zone in a detrimental manner.

The invention aims to provide an improved method for manufacturing a bifocal contact lens of the above-mentioned type.

In a first embodiment of the invention wherein a lens basic part with the desired contact lens diameter is cut centrically on a disc-shaped blank in a usual manner, the method of the invention is characterized in that the optical zone and the periphery are eccentrically cut in the lens basic part, for example by means of an auxiliary tool with a mounting part for mounting in a lathe and a receiving space for the blank mutually shifted along the desired distance, an eccentric collet or a tool mounted eccentrically with respect to the collet.

For making the distance zone on the lens basic part, this lens basic part is attached with its optical zone to a chuck in a usual manner. According to the invention this chuck is mounted on a spindle with a mounting pin with adjustable eccentricity, wherein the eccentricity is adjusted in such a manner that the blank will rotate centrically.

In a second embodiment of the method of the invention the lens basic part is cut eccentrically on the blank with the desired contact lens diameter, for example by means of the above-mentioned auxiliary tool, an eccentric collet or a tool located eccentrically with respect to the collet, whereafter the optical zone and the periphery are cut in the lens basic part centrically with respect to the blank.

In this manner a bifocal contact lens is obtained wherein the thickness of the reading zone is substantially lower so that the contact lens as a whole is thinner than the conventional contact lens. The centre of gravity of the contact lens is located lower due to the eccentrically located optical zone, whereby the position of the contact lens on the eyeball is stable. A much smaller lachrymal film is formed at the reading Zone, whereby the disadvantages of such a lachrymal film are substantially decreased. As the optical zone is located eccentrically, the periphery has a larger size at the location of the reading zone and the lower edge of the contact lens at the reading zone has a higher positive strength which compensates the detrimental effect of the lachrymal film.

The invention will be further explained by reference to the drawings in which an embodiment of the bifocal contact lens of the invention is schematically shown.

Fig. 1 is a front view of a bifocal contact lens obtained by the method according to the invention.

Fig. 2 is an axial section of the bifocal contact lens of Fig. 1.

Fig. 3 schematically shows the contact lens of Fig. 1 during use.

Fig. 4a-4g show subsequent steps in the manufacturing process of a bifocal contact lens according to a first embodiment of the method of the invention.

Fig. 5a-5c show some steps in the manufacturing process of a bifocal contact lens according to a second embodiment of the method of the invention.

Fig. 6a-6b show a side view and a rear view, respectively, of an auxiliary tool for implementing the method according to the invention.

Fig. 7a and 7b show a side view and a front view, respectively, of an auxiliary tool for implementing the method according to the invention.

Fig. 8a and 8b show auxiliary means to be used in the second embodiment of the method of the invention.

Fig. 1 and 2 show a front view and a side view, respectively, of a bifocal contact lens 1 comprising an optical zone 2 and a periphery 3. The axis of the optical zone 2 is shifted with respect to the axis of the contact lens 1 in such a manner that an inner prism is obtained with the desired prism dioptre. The contact lens 1 comprises a distance zone 4 and a reading zone 5.

Fig. 2 shows the different radii R1-R4, in which the different lens surfaces are cut. The optical zone 2 has an axis 6 and is cut with the radius R1 which is usually indicated as basic curve radius. The periphery 3 has the axis 6 in common with the optical zone and is cut with a radius R2 which is usually indicated as periphery radius. The distance zone 4 has the axis 7 of the contact lens 1 and is cut with a radius R3 which is indicated as the distance zone radius. Finally, the reading zone 5 has the axis 6 and is cut with a radius R4 which is indicated as reading zone radius.

The bifocal contact lens 1 described has the important advantage that the reading zone 5 is substantially thinner than the reading zone of the usual bifocal contact lens, wherein the optical zone and the periphery are provided centrically in the contact lens. Thereby the complete bifocal contact lens is thinner and the centre of gravity is located lower due to the eccentrically provided optical zone. The reading zone 5 has a greater height than in the usual bifocal lens because it is not necessary to bevel the lower part, whereby the effective operation of the reading zone 5 is improved. As schematically indicated in Fig. 3 the lack of the bevel at the lower part of the contact lens 1 results in a reduced height of the lachrymal film on the contact lens. Further, the periphery 3 has a greater width at the location of the reading zone 5, in particular at the lower most edge of the reading zone, whereby the contact lens 1 has a higher positive strength at this part. This higher positive strength compensates the detrimental effect of the lachrymal film. Experiments have shown that the bifocal contact lens described is very comfortable in use.

The bifocal contact lens 1 described can be manufactured in different manners. Fig. 4a-4g show schematically some steps of a first method for manufacturing the bifocal contact lens. Fig. 4a and 4b show a section and a top view of a blank 8, on which a lens basic part with the desired diameter of the final contact lens is cut centrically in a usual manner. The blank 8 with the lens basic part 9 is shown in Fig. 4c and 4d, wherein the optical zone 2 and the periphery 3 are cut with the axis 6 in the lens basic part, wherein for illustrating the shift of the optical zone 2, the axis 7 of the lens basic part 9 is also indicated.

Different auxiliary tools can be used to cut the optical zone 2 and the periphery 3. A first auxiliary tool 10 is shown in Fig. 6a and 6b, which tool can be used to cut the optical zone 2 and the periphery 3 in the lens basic part 9 if a standard lathe is used. This auxiliary tool 10 is provided with a mounting part 11, with which the auxiliary tool 10 is clamped in a collet of the lathe, and a receiving space 12 in which the blank 8 is attached with the unmachined side, for example by means of wax. As indicated by the axis lines of the mounting part 11 and the receiving space 12, these parts are mutually shifted.

As an alternative it is possible to use a collet 13 shown in Fig. 7a and 7b, which collet 13 is provided with an opening 14 for receiving the blank 8, which opening is shifted with respect to the axis of the collet 13 along the desired distance.

For further manufacturing the contact lens 1, the blank 8 is attached with its optical zone 2 on a chuck 15 in a usual manner, wherein due to the eccentrically located optical zone, the axis 7 of the blank 8 is shifted with respect to the axis 16 of the chuck 15 (see Fig. 4e). The chuck 15 is fixed on a mounting pin 17 with adjustable eccentricity of a spindle 18, wherein the mounting pin 17 is located eccentrically with respect to the axis 19 of the spindle 18. The eccentricity of the mounting pin 17 is adjusted in such a manner that the axis 7 of the blank 8 coincides with the axis 19 of the spindle 18 (see Fig. 4f), so that during rotation of the spindle the blank 8 and the lens basic part 9 are rotating around the axis 7. The distance zone 4 can now be cut with the radius R3 (see Fig. 2) in the usual manner on the contact lens 1. Subsequently, the chuck 15 is mounted on a spindle 20 with centrical mounting pin 21, so that the lens basic part rotates around the axis 6 of the optical zone 2 and the reading zone 5 is cut with the radius R4 (see Fig. 2) on the contact lens (see Fig. 4g).

Of course polishing is done in the usual manner after each cutting operation. Finally, a truncation (not further shown) is made at the lower edge of the reading zone 5 in the usual manner and the edge of the lens is finished.

In Fig. 5a-5c an alternative method is illustrated, wherein a lens basic part 23 with the desired diameter of the contact lens to be manufactured is cut eccentrically on a blank 22. For cutting this lens basic part 23, the auxiliary tool 10 or the collet 13 can be used.

As indicated in Fig. 5b and 5c, the optical zone 2 and the periphery 3 can be cut in this case in the usual manner with a centric collet, so that the optical zone 2 and the periphery 3 will be shifted with respect to the diameter of the lens basic part 23.

For cutting the distance zone 4 on the lens basic part 23 the blank 22 is attached with its optical zone 2 on the chuck 15, for example by means of wax. In this case the axis of the blank 22 coincides with the axis 16 of the chuck 15, so that the lens basic part 23 is located eccentrically with respect to the chuck 15. For cutting the distance zone 4 the chuck 15 is mounted on the spindle 18 with eccentric mounting pin 17 in such a manner that the axis of the lens basic part 23 coincides with the rotation axis of the spindle 18. To this end the highest point of the lens basic part 23 with respect to the blank 22 is marked on this blank, as schematically indicated by reference numeral 24, while in the same manner the lowest point of the mounting pin 17 is marked on the spindle 18. The marks are thereafter brought opposite to each other. Of course it is also possible to mark the lowest point of the lens basic part 23 and the highest point of the mounting pin.

Fig. 8a and 8b show some auxiliary means for mounting the lens basic part 23 in a very simple

manner in the correct position in an accessory for cutting the distance zone 4 on the lens basic part 23. These auxiliary means comprise in the first place a special chuck 25 with a fixed collar 26 and a rotatable collar 27. The collar 27 is fixed on the chuck 25 by a friction coupling so that the collar 27 cannot be rotated unintentionally. The chuck 25 has an opening 28 for mounting the chuck on the centric mounting pin 21 of the spindle 20. First the chuck 25 with its end with the opening 28 is mounted in a holder 29 with receiving space 30, wherein a pin 31 of the holder 29 engages into an opening 32 of the fixed collar 26. Thereby the chuck 25 is locked against rotation in the receiving space 30 of the holder 29. An adjustment ring 33 can be brought on the chuck 25, wherein a coupling pin 34 of the adjustment ring 33 engages into an opening of the rotatable collar 27. The adjustment ring 33 has a marker line 36 which has to be aligned with the marker 24 of the blank 22 by rotation of the adjustment ring 33.

Subsequently the chuck 25 is mounted in an accessory 37 having a receiving space 38. This receiving space 38 is located eccentrically with respect to a tapered shaft opening 39 with which the accessory 37 can be mounted for example on the centric mounting pin 21 of the spindle 20. The accessory 37 has a positioning pin 40. The chuck 25 must be located in the receiving space 38 in such a manner that the opening 35 of the collar 27 engages this positioning pin 40. The chuck 25 is fixed in the accessory 37 by means of a locking bolt 41.

Because this positioning pin 40 indicates the lowest point of the eccentrical receiving space 38, the centre line of the lens basic part 23 will be aligned with the axis of the tapered space 39. Now it is simple to cut the distance zone 4 with the radius R3 (see Fig. 2) on the lens basic part 23 by using the standard spindle 20 with centric mounting pin 21.

Finally, the reading zone 5 is cut by mounting the chuck 25 directly on the spindle 20 with centric mounting pin 21. Of course also in this case polishing is done in a usual manner and a truncation is provided. In this case the truncation is preferably provided before the distance zone 4 and the reading zone 5, respectively, are cut.

It is noted that the method according to Fig. 8a and 8b has the important advantage that manufacturing these special contact lenses with shifted optical zone can be easily included in the series of operations for manufacturing usual contact lenses, wherein moreover the same apparatus can be used. Thereby, the costs for using this method are restricted.

It is noted that shifting the optical zone can advantageously be applied in manufacturing single focus contact lenses too. By shifting the optical zone an inner prism is formed and the centre of gravity of the contact lens is lowered, whereby the so-called "high riding" can be countered.

The invention is not restricted to the above-described embodiments which can be varied in a number of ways within the scope of the invention.

Claims

1. Method for manufacturing a contact lens comprising an optical zone and a periphery, wherein the optical zone is shifted with respect to the axis of the contact lens in such a manner that an inner prism is obtained with the desired prism dioptre, wherein a lens basic part with the desired contact lens diameter is cut centrically on a disc-shaped blank, **characterized** in that the optical zone and the periphery are eccentrically cut in the lens basic part, for example by means of an auxiliary tool with a mounting part for mounting in a lathe and a receiving space for the blank mutually shifted along the desired distance, an eccentric collet or a tool mounted eccentrically with respect to the collet.

2. Method according to claim 1, wherein the distance zone is cut on the lens basic part and the lens basic part is attached to a chuck with its optical zone, **characterized** in that the chuck is mounted on a spindle with a mounting pin with adjustable eccentricity, wherein the eccentricity is adjusted in such a manner that the blank will rotate centrically.

3. Method for manufacturing a contact lens comprising an optical zone and a periphery, wherein the optical zone is shifted with respect to the axis of the contact lens in such a manner that an inner prism is obtained with the desired prism dioptre, **characterized** in that a lens basic part with the desired contact lens diameter is cut eccentrically on a blank, for example by means of the auxiliary tool of claim 1, an eccentric collet or a tool located eccentrically with respect to the collet, whereafter the optical zone and the periphery are cut centrically with respect to the blank in the lens basic part.

4. Method according to claim 3, wherein for cutting the distance zone on the lens basic part, the lens basic part is attached with its optical zone to a chuck which is rotated around the axis of the lens basic part.

5. Method according to claim 4, **characterized** in that the chuck is mounted on a spindle with a mounting pin with adjustable eccentricity, wherein the eccentricity is adjusted in such a manner that the lens basic part is centric with the rotation axis of the spindle, wherein preferably after cutting the lens basic part, the blank is marked at the location of the highest point of the lens basic part with respect to the blank, wherein the spindle is marked at the lowest point of the eccentric mounting pin, or vice versa, and wherein the chuck with the blank is mounted on the mounting pin in such a manner that the marks are opposite to each other.

6. Method according to claim 4, **characterized** in that the chuck is mounted in a holder in a non rotatable manner, wherein a positioning ring with positioning opening which is rotatably mounted on the chuck, is adjusted in a predetermined position with respect to a marker of the highest or lowest point of the lens basic part with respect to the blank by means of an adjustment ring, whereafter the chuck is mounted in an accessory with a receiving space for the chuck which is eccentric with respect to a shaft part and/or shaft opening, said accessory having a positioning pin indicated the highest or lowest point of the eccentricity of the receiving space, wherein the chuck is mounted in the accessory in such a manner that the positioning opening of the positioning ring engages the positioning pin.

7. Method according to claim 2, 5 or 6, **characterized** in that the chuck is mounted on a centric spindle for cutting the reading zone.

8. Auxiliary tool to be used in the method according to anyone of the preceding claims, **characterized** by a mounting part for mounting in a lathe and a receiving space for a blank, wherein the mounting part and the receiving space are mutually shifted.

9. Auxiliary tool assembly to be used in the method according to anyone of claims 3-7, **characterized** by a chuck having a rotatable positioning ring with positioning opening, a holder for the chuck in which the chuck can be held in a non-rotatable manner, an adjustment ring for rotating the positioning ring on the chuck and an accessory with a receiving space lying eccentrically with respect to a shaft part and/or shaft opening of the accessory and with a positioning pin indicating the lowest or highest point of eccentricity and adapted to cooperate with the positioning opening of the positioning ring of the chuck.

10. Collet to be used in the method according to anyone of claims 1-7, **characterized** by a eceiving opening for clamping a blank, said receiving opening being eccentric with respect to the rotation axis of the collet.

11. Spindle to be used in the method according to anyone of claims 1-7, **characterized** by a mounting pin with adjustable eccentricity.

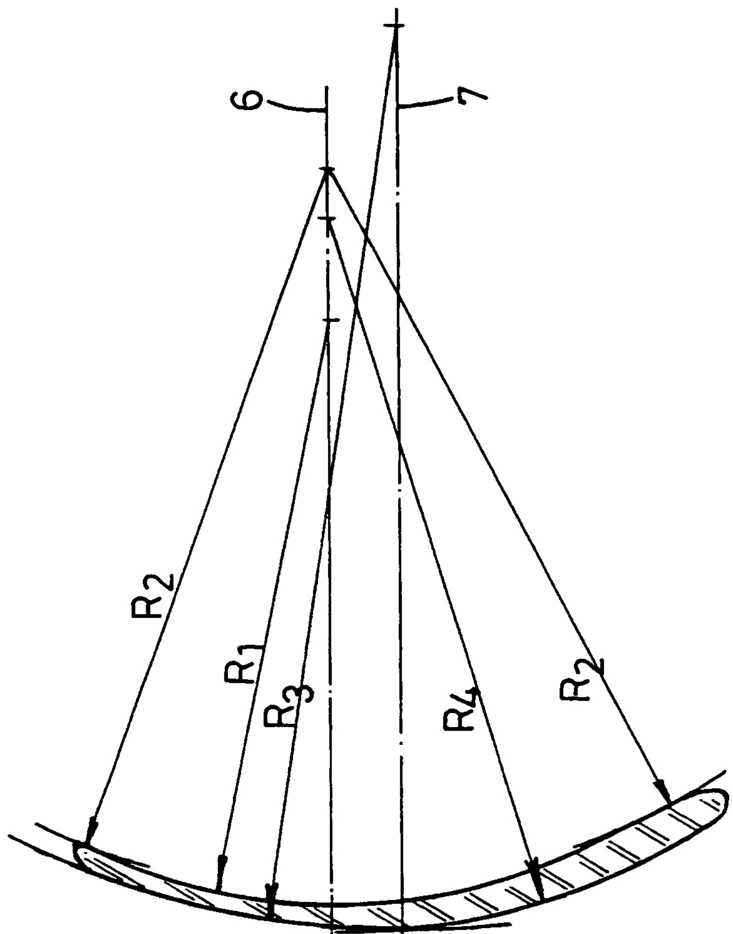


Fig.2

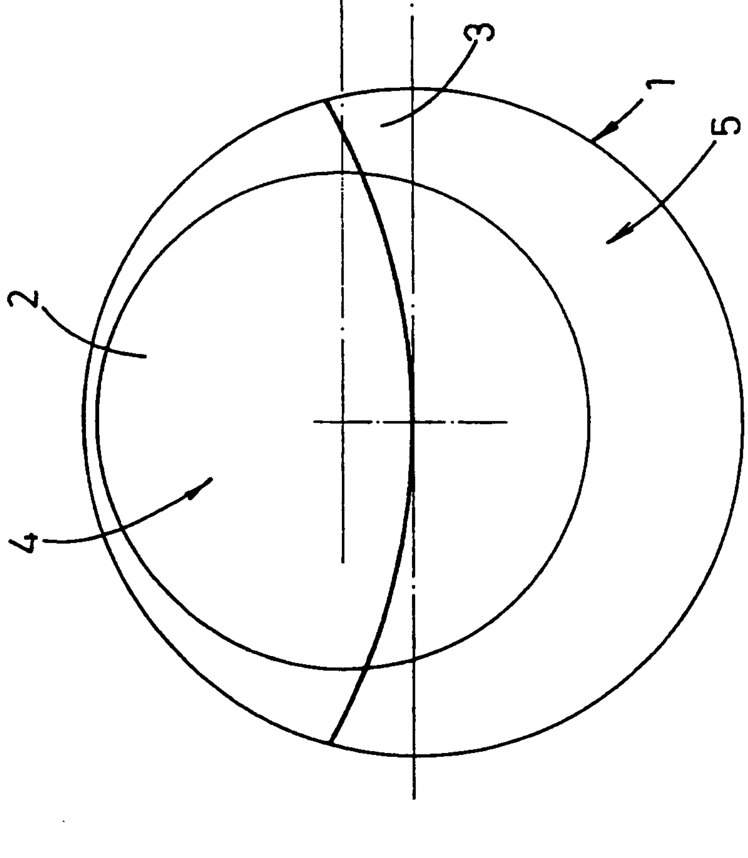


Fig.1

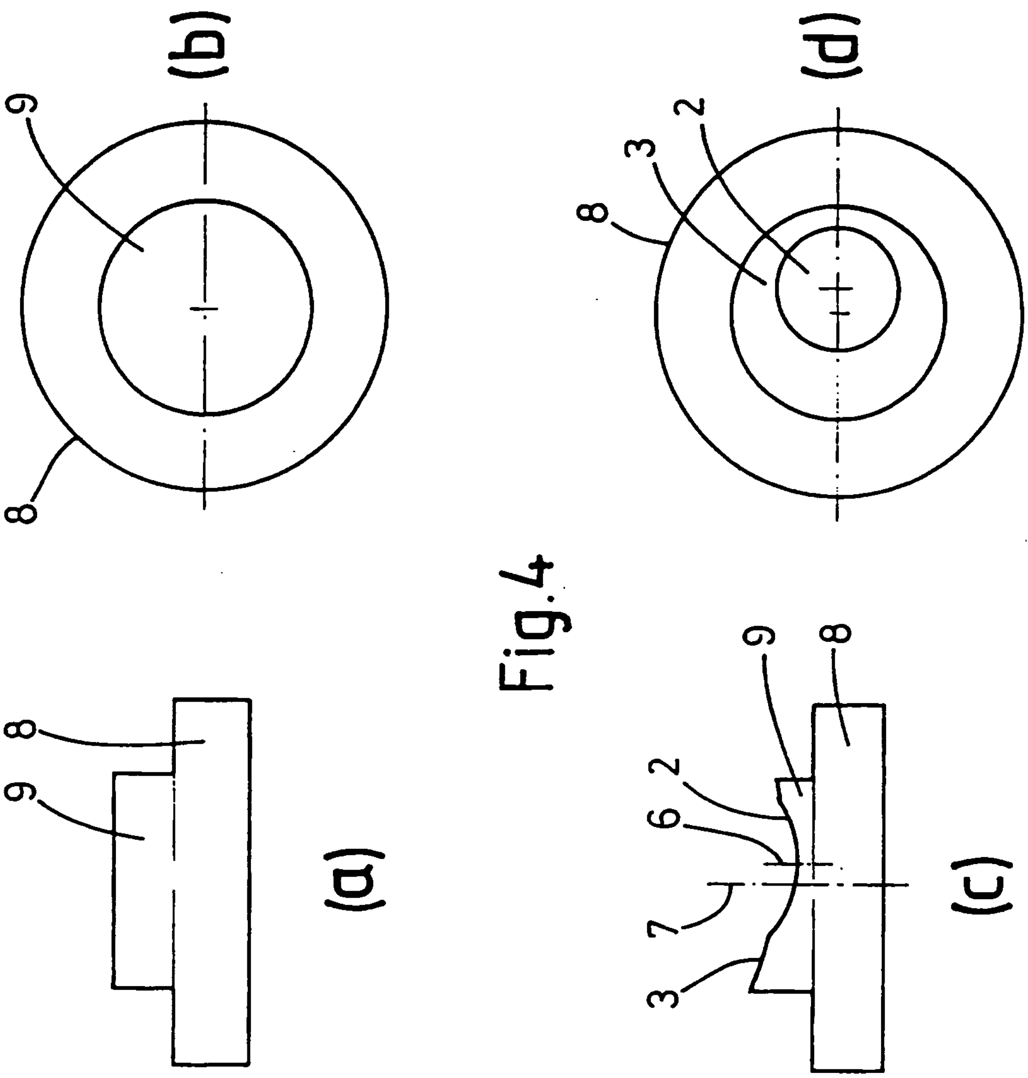


Fig.4

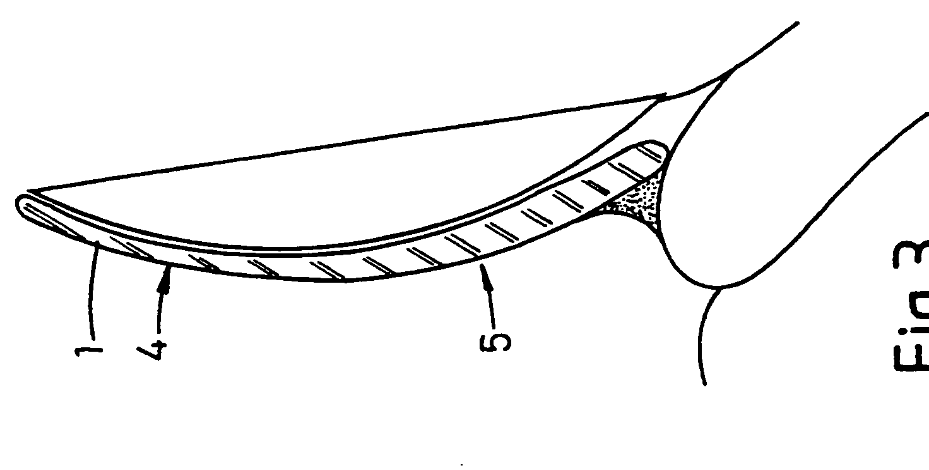


Fig.3

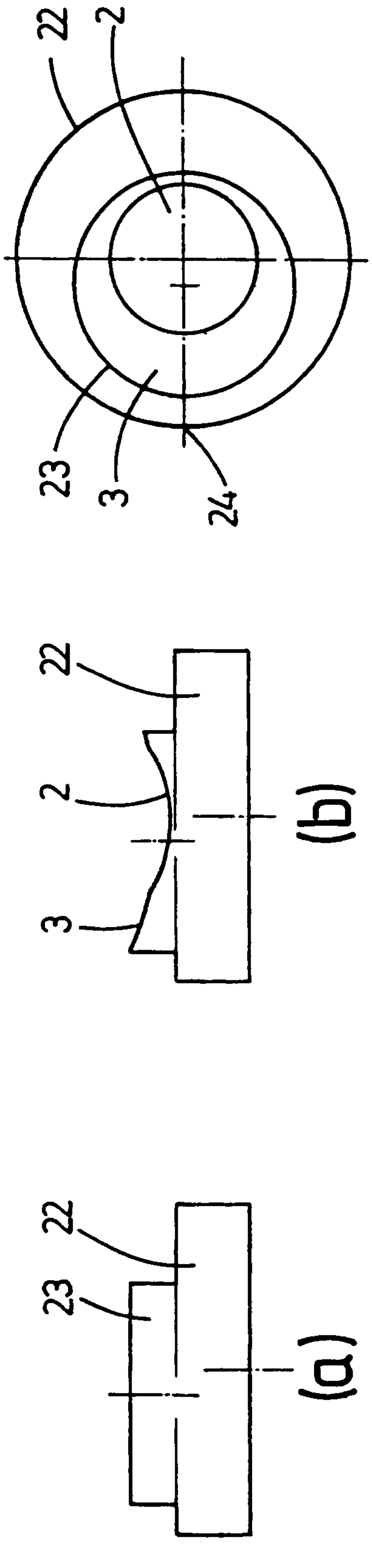


Fig.5

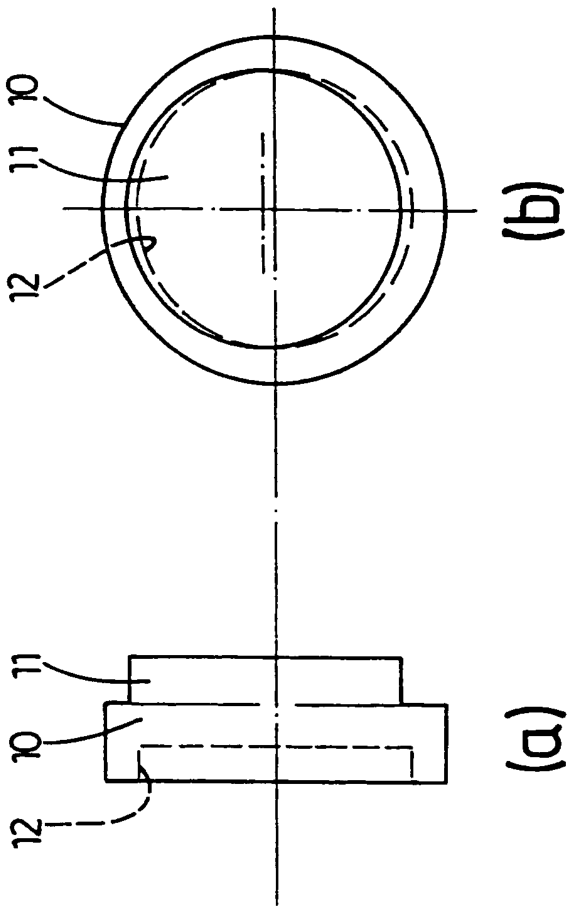
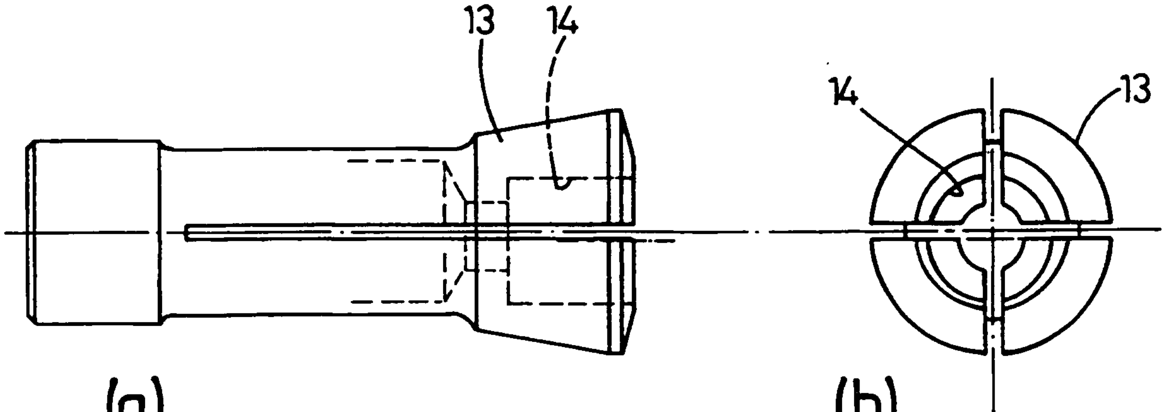
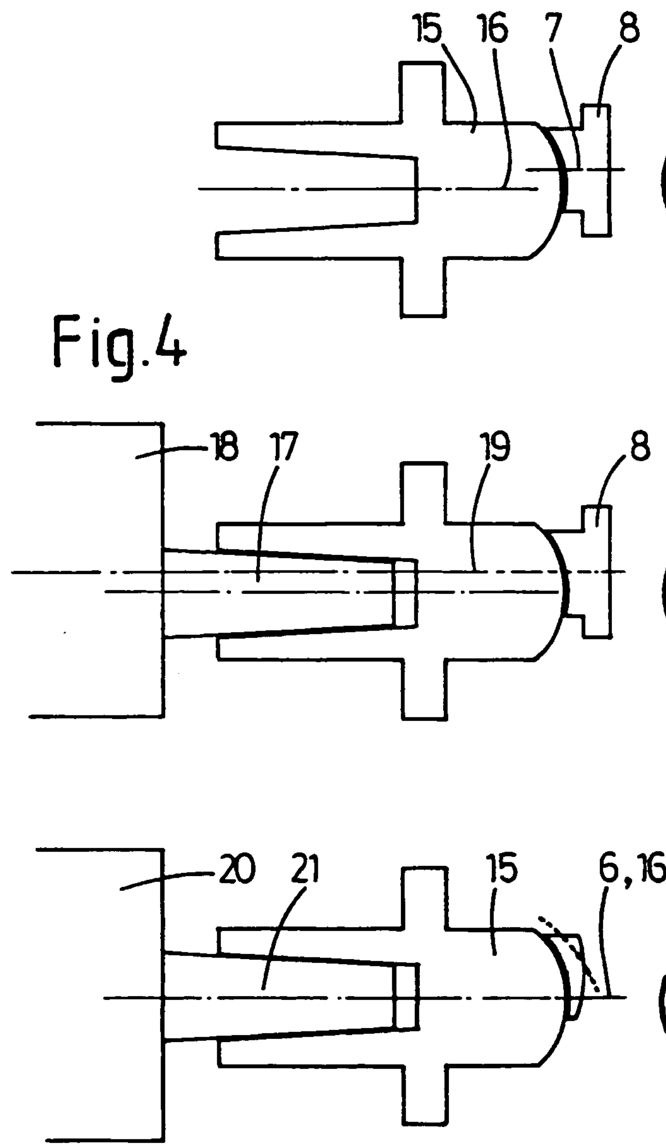


Fig.6



(a) (b)

Fig.7



(e)

Fig.4

(f)

(g)

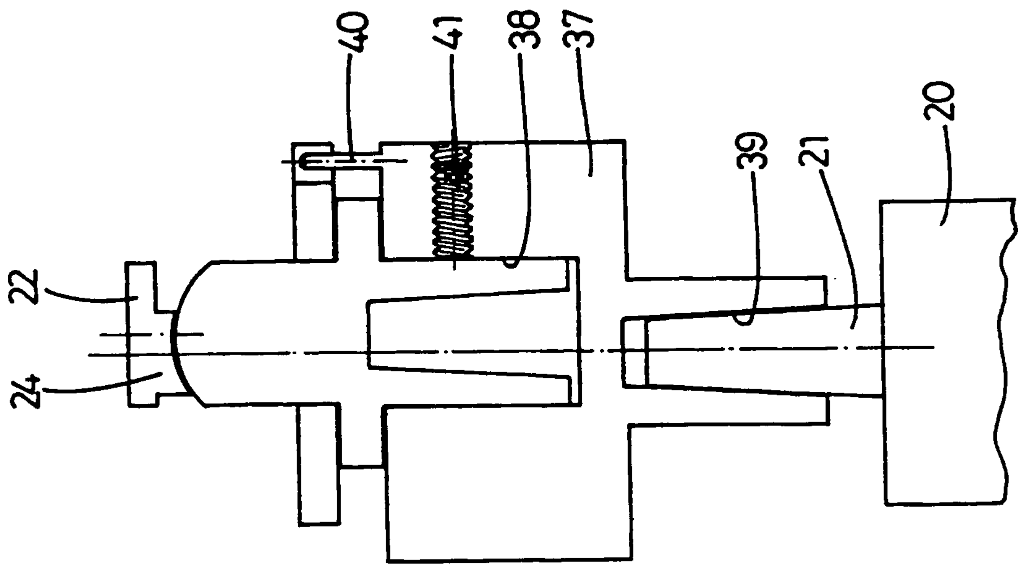


Fig.8B

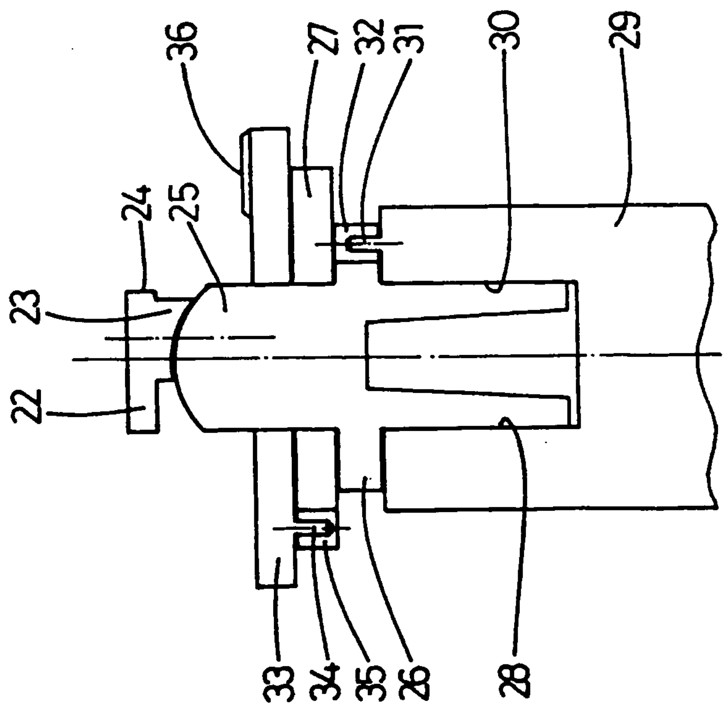


Fig.8A

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EUROPEAN SEARCH REPORT

Application Number

EP 93 20 0527

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-5 074 082 (Q. CAPELLI) * column 2, line 48 - column 5, line 12; figures 1-12 * ---	1-3,7,8, 10,11	G02C7/04 B24B13/005
A	EP-A-0 325 673 (W. KUNZLER) * column 4, line 34 - line 53; figure 3 * ---	2,7,11	
A	US-A-4 202 848 (C. NEEFE) * column 2, line 12 - line 28; figures 1,2 * ---	6,7,10	
A	DE-A-3 817 334 (HECHT GMBH) ---		
A	US-A-4 854 089 (MORALES) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02 AUGUST 1993	ESCHBACH D.P.M.

CATEGORY OF CITED DOCUMENTS

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